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WHAT IS CLAIMED IS:

- 1. A method of compressing video signals, the method comprising:
 - a) transforming both a current frame and a reference frame using a wavelet transform having multiple levels, producing transformed image data;
- b) performing motion compensation to low-frequency band at a lowest level of the transformed image data producing motion-compensated, transformed image data;
 - applying band or phase shifting methods to obtain an overcomplete expansion of the reference frame;
 - d) performing motion compensation of high-frequency bands at the lowest level of the transformed image data using the overcomplete expansion;
 - e) applying one-level inverse transform to the reference frame to produce a reconstructed image at a next resolution level;
 - f) setting the next resolution level to be the lowest level; and
 - g) repeating the above process the process reaches the highest resolution level.
- 2. The method of claim 1, wherein the multiple levels of wavelet transform is substantially equal to two.
- The method of claim 1, wherein the method further comprises providing resolution scalability by performing motion estimation to a multi-resolution representation of video signals.
- 4. The method of claim 1, wherein the method further comprises providing rate scalability by embedded compression of motion-compensated prediction residues at different resolutions.
- 5. The method of claim 1, wherein performing motion estimation further comprises hierarchical motion estimation, wherein motion vectors estimated from a low band can be used as an initial estimate of motion vectors for high bands at a same level.
- 6. The method of claim 1, wherein the motion compensation method of high bands further comprises:
 - a) using an overcomplete expansion of the reference frame operable to restore accuracy of a motion field;
 - b) linearly interpolating in the wavelet domain operable to enhance accuracy of the motion field;
 - c) combining the overcomplete expansion and the linear interpolation operable to enhance the accuracy of motion field in the wavelet domain.

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- 7. The method of claim 3, wherein providing resolution scalability further comprises
 - a) developing a non-expanding multi-resolution representation of video signals;
 - b) performing motion estimation and compensation independently at different resolution levels;
- c) applying a hierarchical motion estimation technique designed for multi-resolution representation of video signals;
 - 8. The method of claim 4, wherein providing rate scalability further comprises:
 - a) offering an embedded bit stream by sequentially compressing coefficients from low resolution level to high resolution level; and
 - b) offering an embedded bit stream by sequentially scanning bit planes of coefficients within each band.
 - 9. The method of claim 5, wherein hierarchical motion estimation further comprises:
 - using an estimated motion vector at a lower resolution level as an initial estimate reducing computations needed to search for an optimal motion vector at a higher resolution level;
 - b) using the estimated motion vector at a lower resolution level as an initial estimate reducing a search range needed to find the optimal motion vector at a higher resolution level.
 - 10. The method of claim 6, wherein using the overcomplete-expansion further comprises:
 - a) Applying an inverse wavelet transform at a first level;
 - b) shifting a reconstructed low band at a next level along vertical, horizontal and diagonal directions;
 - c) applying forward wavelet transform;
 - d) applying a direct linear time invariant phase shifting filter operable to obtain nonzerophase wavelet coefficients from zero-phase coefficients; and
 - e) applying a non-decimated wavelet transform to the reconstructed low-band signal;
 - 11. The method of claim 6, wherein linearly interpolating further comprises:
 - a) applying an inverse transform operable to obtain a reconstructed signal;
 - b) linearly interpolating the reconstructed signal;
 - c) applying a forward wavelet transform; and
 - d) linearly interpolating transform coefficients directly in the wavelet domain;
 - 12. A computer-readable medium including software code that, when executed, causes the computer to:

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- a) transform both a current frame and a reference frame using a wavelet transform having multiple levels, producing transformed image data;
- b) perform motion compensation to low-frequency band at a lowest level of the transformed image data producing motion-compensated, transformed image data;
- c) apply band or phase shifting methods to obtain an overcomplete expansion of the reference frame;
- d) perform motion compensation of high-frequency bands at the lowest level of the transformed image data using the overcomplete expansion;
- e) apply one-level inverse transform to the reference frame to produce a reconstructed image at a next resolution level;
- f) set the next resolution level to be the lowest level; and
- g) repeat the above process the process reaches the highest resolution level.

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